MonPE25

Gas Flow and Density Profile in NIO1 Accelerator and Vessel

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NIO1 (Negative Ion Optimization 1) is a versatile ion source constructed to study the physics of production and acceleration of H- beams up to 60 keV [1]. In ion sources, the gas is steadily injected in the plasma source to sustain the discharge, while high vacuum is maintained by a dedicated pumping system located in the vessel. In order to study the processes occurring during the acceleration phase in between the electrodes and also downstream, with respect to the accelerator, knowledge of the density of the background gas is required: in electrostatic accelerators of negative ions, extracted beam ions are lost by collision processes with the background gas, attenuating the beam current, affecting the beam space charge, and causing heat deposition onto the electrodes by stray particles and onto the source backplate by back-streaming positive ions.
In this paper, the three dimensional gas flow in NIO1 is studied in the molecular flow regime by the Avocado code [2]. The analysis of the gas density profile along the accelerator considers the influence of effective gas temperature in the source, of the gas temperature accommodation by collisions at walls, and of the gas particle mass. The calculated source and vessel pressures are compared with experimental measurements in NIO1 during steady gas injection.

This projects has received funding from the European Union's Horizon 2020 research and innovation program.

References

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